



**UTTARANCHAL
UNIVERSITY**

UTTARANCHALUNIVERSITY

ArcadiaGrant,P.O.Chandanwari, Premnagar,Dehradun, Uttarakhand-

248007,INDIA

Detailed Course Structure & Syllabus Of Pre Ph.D. (Environmental Science)

Course Work

(As per CBCS system)

W.E.F Session 2022-23



**Course Structure of the Pre-Ph.D (Environmental Science) Course Work:
Applicable for Batch: 2022-23**

SCHEME OF EXAMINATION

**Ph.D (Environmental Science)
(Effective from Academic Year 2022-23)**

Under Choice Based Credit System (CBCS)

**Course Structure of the Pre-Ph.D (Environmental Science) Course Work:
Applicable for Batch: 2022-23**

Scheme of Pre-Ph.D. Course Work

S.No	Course Code	Subject	Credits	Evaluation - Scheme							
				Period			Sessional			Examination	
				L	T	P	CT- I	CT- II	Total	ESE	Sub. Total
Courses											
1.	RM-101	Research Methodology	4	4	0	0	20	20	40	60	100
2.	RM-102	Computer & Stats Application in Research	2	2	0	0	20	20	40	60	100
3.	RPE-103	Research & Publication Ethics	2	2	0	0	20	20	40	60	100
4.	DSE-104	Discipline Specific Electives	3	3	0	0	20	20	40	60	100
5.	RS-105	Seminar Presentation	2	0	0	4	20	20	40	60	100
		Total	13	11	0	4	100	100	200	300	500

List of Electives

S. No.	Course Code	Course Name
1	AR-104	Advanced Research & Instrumentation Techniques
2	EVS- 104(ii)	Fundamentals of Environmental Chemistry
3	EVS- 104(iii)	Biofuels



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SYLLABUS

of

Ph.D(Environmental Science)



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Programme Name	Pre-Ph.D. Course Work	Programme Code	23-
Course Code	RM-101	Credit	4
Year/Sem	1/1	L-T-P	4-0-0
Course Name	Research Methodology		

Objectives of the Course:

1. To Equip the Students with the Concept and Methodology of Research.
2. To provide knowledge about type of research, preparation of reports and thesis, designing of Research using Scientific Methods.

UNIT I (Total Topics- 7 and Hrs-12)

Introduction to Research: Definition, Nature and significance, Role and Objectives; Types of Research: exploratory, descriptive, experimental and diagnostic research, social and legal research and traditional, analytical, empirical & fundamental research, Doctrinal and non-doctrinal research methods; Various Research Designs; Scientific Research Process: Overview, Problem identification and formulation of research statement.

UNIT II (Total Topics- 7 and Hrs- 12)

Data Collection: sources, primary and secondary methods, significance of Primary and Secondary Data, questionnaire Vs. schedules; Data Processing: Editing, Coding Organization and Presentation; Attitude Measurement and scaling: Measurement Scales, Sources of Errors in Measurement, Techniques of Developing Measurement Tools, Classification and Testing (Reliability, Verification and Validity) Scales, Designing Questionnaires and Interviews.

UNIT- III (Total Topics- 5 and Hrs- 10)

Sampling, Sampling Methods, Sampling Plans, Sampling Error, Sampling Distributions: Theory and Design of Sample Survey, Census Vs Sample Enumerations, Objectives and Principles of Sampling, Types of Sampling, Sampling and Non-Sampling Errors, Concept of Permutation, Combination & Probability for research analysis.

UNIT-IV (Total Topics- 5 and Hrs- 10)

Interpretations and Report Writing: Meaning of Interpretation, Techniques of Interpretation, Precautions in Interpretation, Significance of Report Writing, Steps in Report Writing, Layout of Report and Precautions in Writing Research Reports. Limitations of RM: Ethics in Research, Philosophical Issues in Research.

CO1. Acquire in-depth knowledge of various fundamentals, theories and principles related to the research and apply the acquired knowledge in carrying out research studies in the area of interest.

CO2. Identify, formulate and critically investigate research problems by applying research-oriented knowledge and analyze relevant data to reach certain conclusions in the form of alternative solutions to these problems.

CO3. Apply the acquired knowledge and skills to develop minds to think out of the box while carrying out research operations to conclude something.

CO4. Apply parametric and non-parametric statistical tests to verify the developed hypothesis to suggest innovative solutions to the problem being investigated.



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Reference Books

1. William G. Zikmund, "Business Research Methods", Orlando: Dryden Press.
2. C. William Emory and Cooper R. Donald, "Business Research Methods", Boston, Irwin.
3. Fred N Kerlinger, "Foundations of Behavioural Research", New Delhi: Surjeet Publications.
4. Naresh Malhotra, Marketing Research : An Applied Orientation, Pearson publication David Nachmias and ChavaNachmias, "Research Methods in the Social Sciences", New York: St.Marlia's Press.
5. Bhattacharya, D. K. (2004) Research Methodology, New Delhi, Excel Books.



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Programme Name	Pre-Ph.D. Course Work	Programme Code	23-
Course Code	RM-102	Credit	2
Year/Sem	1/1	L-T-P	2-0-0
Course Name	Computer & Stats Application in Research		

Objectives of the Course:

1. To appraise computational skills for research application.
2. To assess statistical method for research analysis.

UNIT I

Characteristics of Computers, Evolution of computers, computer memory, computer generations, Basic computer organization; System software, Application software, introduction to operating system, single user, multi-user, multi-tasking single tasking, application of computer for business and research, MS-windows, Linux .Application of Internet in research : INFLIBNET, Use of Internet, sights (DOAJ), Use of E Journals, Use of E library, use of EBSCO HOST online database of Academic Libraries. Subject/field specific tools on www.freeware.com

UNIT II

Computer Application in Research,. Basic concept of Computer, Use of Internet for Research Purpose: E-mail, WWW, Web browsing, technical skills, drawing inferences from data, Research publishing tools-MS Word, Adobe acrobat, Graphics tool-MS Excel, Presentation tool-MS Power, Data Analysis Software and Analysis Techniques point. Creating presentation and adding effects, Introduction to Data analysis software-SPSS: Definition, objectives and features, data analysis using SPSS.

UNIT- III

Statistical methods for research application in analysis of data, Measurement in Research , data interpretation, Measures of Central Tendency, Measures of Dispersion, Measures of Asymmetry (Skewness), std deviation, Measures of Relationship, Simple Regression Analysis, Correlation and Regression, Partial Correlation.

UNIT-IV

Statistical Tools-Hypothesis and Hypothesis Testing: Parametric & Non-Parametric Tests, Important Parametric Tests ,Hypothesis Testing of Correlation Coefficients ,U Test, Chi Square Test, ,T-Test.Analysis of Variance (ANOVA) , The Basic Principle of ANOVA ,ANOVA Technique, Setting up Analysis of Variance Table, Short-cut Method for One-way ANOVA, Coding Method, Two-way ANOVA .

Course Outcomes:

- CO1.** Acquire knowledge of concept of computer with application in Research.
- CO2.** Apply acquired knowledge of computer for presentation skills.
- CO3.** Acquire knowledge of statistical methods for Research.
- CO4.** Apply acquired knowledge to describe the inductive nature of quantitative data analysis.



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Reference Books

1. C. R. Kothari, "Research Methodology: Methods and techniques", New Delhi: Vishwa Prakashan.
2. Brymann, Alan and Carmer, D. (1995) Qualitative data analysis for social scientist, New York, Routledge Publication.
3. Jain, Satish: "Introduction to Computer Science and basic Programming." BPB Publications, New Delhi, 1990. •
Rajaraman, V., "Fundamental of Computers", Prentice Hall of India, New Delhi, 1996.



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Programme Name	Pre-Ph.D. Course Work	Programme Code	23-
Course Code	RPE-103	Credit	2
Year/Sem	1/1	L-T-P	2-0-0
Course Name	Research & Publication Ethics		

Objectives of the Course:

Its objectives to provide knowledge about ethics and code of research publication with concept of plagiarism.

UNIT I (Total Topics- 2 and Hrs-8)

1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgments and reactions

UNIT II (Total Topics- 5 and Hrs- 5)

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

UNIT- III (Total Topics-7 and Hrs-7)

1. Publication ethics: definition, introduction and importance
2. Best practices/ standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

UNIT- IV (Total Topics-4 and Hrs-4)

Practice

Open Access Publishing

1. Open access publications and initiatives
2. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder/ Journal suggestion tools viz. JANE, Elsevier Journal finder, Springer Journal Suggester, etc.

CO1. Recognize the basics of philosophy of science & ethics, research integrity, publication ethics and theories of research ethics.

CO2. Familiarize with important issues in research ethics, research integrity, scientific misconduct and misinterpretation of data.

CO3. Analyze the best practices for publications, publication ethics and identify the predatory publishers & journals.

CO4. Demonstrate & use plagiarism software tools, open-source software tools, citation databases and



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research metrics.

CO5. Publish credible & scholarly publications in reputed peer-reviewed journals.

References-

Research and Publication Ethics, Dr Sumanta Dutta, Bharti Publications, 2021

Research and Publication Ethics, Dr Santosh Kumar Yadav, Anne Publications, 2020



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Programme Name	Pre-Ph.D. Course Work	Programme Code	23-
Course Code	RS- 105	Credit	2
Year/Sem	1/1	L-T-P	0-0-4
Course Name	Seminar Presentation		

Objectives of the Course:

Main objective of this course is to develop presentation skills in the scholars and knowledge about review of literature so that they can review properly for utilisation in their research work.

Seminar Presentation-Candidate/Research Scholar has to go through the review of literature in the concerned field of research. Review of literature guidelines will be given by the concerned faculty/Dean of Department/School/College. Research Scholar has to prepare presentation on review of literature in the concerned field/ topic assigned by the department (DRC) periodically during course work. There will be minimum 3 presentations of review of literature during pre-Ph.D. course work.

- First presentation will be required in DRC/FRC for review of literature with concerned Department focus on area of research. It will be evaluated and assessment sheet will be sent from Department to Dean Research & Studies office.
- Similarly second presentation will be required by research scholar with extension of first presentation and more number of references would be added.

Internal & end term examination marks will be as per scheme. Each presentation is to be assessed by the department as per instructions from Dean-Research & Studies.

Final presentation would be required at the time of end term/sem. examination on proposed synopsis. General guidelines would be issued by Dean-Research for seminar presentation.

Course outcomes

CO1. Research Scholar would be able to develop & explore the review of literature in concerned area.

CO2. Analyze review of literature critically for finding the research gap.

CO3. Apply acquired knowledge in making systematic seminar presentations.

CO4. Apply acquired knowledge for improving development of all-round research.



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Programme Name	Pre-Ph.D. Course Work	Programme Code	23-
Course Code	AR-104	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	Advanced Research & Instrumentation Techniques		

Objectives of the Course:

1. To learn & apply concept of Thermogravimetric techniques in research.
2. To provide knowledge about spectroscopic techniques for research.

UNIT I (Total Topics-12 and Hrs-12)

UV-Visible spectroscopy

Basic principle, Various electronic transitions Beer-Lambert law, effect of solvent on electronic transitions, molar extinction coefficient, concept of chromophores and auxochromes, bathochromic, hypsochromic, hyperchromic and hypochromic, UV spectra of conjugated enes and enones, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Woodward-Fiesher rules for conjugate dienes and carbonyl compounds.

Infrared spectroscopy

Infra-red spectroscopy: Basic principle, Instrumentation Selection rules, fundamental modes of vibration, overtones, combination bands, Fermi resonance, Factors affecting IR spectra. Effect of hydrogen bonding, solvent effect on IR of gaseous, solids and polymeric Interactions with molecules: absorption and scattering. Means of excitation (light sources), detection of the signal (heat differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR). Interpretation of IR spectra of aliphatic, aromatic hydrocarbons, amines, amides, carbonyl compounds etc

UNIT- II (Total Topics- 12 and Hrs-12)

NMR spectroscopy

Principle, Instrumentation, Factors affecting chemical shift, Uses of TMS equivalent and non-equivalent protons, chemical shifts, factors affecting chemical shifts, shielding of magnetic nuclei, deshielding, anisotropic effects in alkene, alkyne, aldehydes and aromatics, spin-spin coupling, coupling constant, chemical exchange, Simple applications, Interpretation of NMR spectra of aliphatic, aromatic hydrocarbons, carbonyl compounds etc.

Thermal methods of analysis:

Thermal methods: Principle & application of Thermogravimetric analysis; TGA, DTA & DSC , DSC : Principle instrumentation and applications.



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UNIT-III (Total Topics- 12 and Hrs- 12)

Microscopic Techniques: Preparation of Thin-films, Physical vapor deposition, Evaporation Techniques-Sputtering (RF & DC), Spin Coating, Pulsed Laser deposition, Working Principle of X-ray Diffractometer, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Scanning tunneling microscopy (STM), Introduction & application of Bio analytical techniques

UNIT-IV (Total Topics- 12 and Hrs-12)

Physical instrumentation techniques: Physical Properties: Introduction, & applications of different physical Characteristics: Viscosity, optical activity & conductivity, Instrumentation: Viscometer, pH meter, Refractometer, Polarimeter.

CO-1: Inculcate knowledge about advanced techniques for physical parameters of materials.

CO-2: Apprise UV visible & Spectroscopic techniques.

CO-3: Learn interpretation of data used in spectroscopy analysis.

CO-4: Learn principle and method of microscopic & thermogravimetric techniques for characterisation of material for research.

Reference Books:

1. Spectroscopy of Organic Compounds, New Age International Publishers; PS Kalsi
2. Spectrometric Identification of Organic Compounds, John Wiley; Silverstein, Robert M.; Webster, Francis X.; Kiemle
3. Practical NMR Spectroscopy, ML Martin, JJ Delpach and GJ Martin, Heyden.
4. Fundamentals of Molecular Spectroscopy Colin N. Banwell and Elaine M. Mc Cash Tata McGraw Hill.
5. Introduction to NMR Spectroscopy: RJ Abraham, J Fischer and P Loftus, Wiley.
6. Spectroscopic Method in Organic Chemistry: DH Williams, I Fleming, Tata MacGraw Hill.
7. Instrumental Method of Analysis: Seventh Edition, Willard Merritt, Dean, Settle. CBS



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Programme Name	Pre-Ph.D. Course Work	Programme Code	23-
Course Code	EVS- 104 (ii)	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	Fundamentals of Environmental Chemistry		

Objectives of the Course:

1. To provide detailed understating of various aspects of air chemistry.
2. To acquire knowledge of various aspects of water Chemistry.
3. To appraise various aspects of soil chemistry.
4. To explain chemical constituent s present in the environment, interactions between them and manner in which changes are brought about due to pollution.

UNIT I (Total Topics-13 and Hrs-8)

Chemistry for Environment

Fundamental of environmental chemistry: Mole Concept, Solution chemistry, solubility product, Solubility of gases, Phase change, thermodynamics, Electrochemistry and redox reactions, Gibbs' free energy; Chemical potential; chemical kinetics and chemical equilibrium. Sources of natural and artificial radiations. Applications and handling of isotopes and other radionuclides in environment.

UNIT II (Total Topics-09 and Hrs-8)

Air Chemistry

Atmospheric Chemistry: Chemical composition of atmosphere- atmospheric water and CO₂; particles, ions and radicals in atmosphere, formation of particulate matter, Photo-chemical and chemical reactions in the atmosphere, thermal inversion, photochemical smog, acid rain, chemistry of ozone layer depletion; greenhouse gases and global warming.

UNIT- III (Total Topics-07 and Hrs-6)

Water Chemistry

Aquatic chemistry: Structure and properties of water, Water quality parameters, Physico- chemical concepts of color, odour, turbidity, pH, conductivity, DO, COD, BOD, alkalinity, carbonate system in water, redox reactions.

UNIT-IV (Total Topics-15 and Hrs-10)

Soil and Geochemistry

Soil Chemistry: Physio-chemical composition of soil, humus, Inorganic and organic components of soil, nutrients (NPK) in soil, And significance of C: N ratio, Cation exchange capacity (CEC), Reactions in soil solution. Environmental geochemistry: Concept of major, trace and REE. Classification of trace elements, Biochemical aspects of Arsenic, Cadmium, Lead, Mercury, Carbon monoxide, O₃, PAN, MIC and other carcinogens

UNIT-V (Total Topics- 12 and Hrs-8)

Biologically Important Molecule

Chemistry of Biologically Important Molecules, Chemistry of Water, Unusual physical properties, hydrogen bonding in biological systems, unusual solvent properties, changes in water properties by addition of solute.

CO-1: Develop concepts of basic chemistry associated with the occurrence of environmental pollutants.



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CO-2: Understand various aspects of air and water chemistry so as to acquaint students with chemical constituents present in air and water, interactions among them and manner in which changes are brought about due to pollution.

CO-3: Describe the basic aspects of soil chemistry and environmental toxicants.

CO-4: Understand the latest technologies including green chemistry to reduce the impacts of pollutants in the environment.

Reference Books:

1. Baird, C. and Cann, M.).Environmental Chemistry, W.H. Freeman, USA.
2. Manahan, S. E. Fundamentals of Environmental Chemistry, CRC Press, USA.
3. Connell D.W.Basic concepts of Environmental Chemistry, CRC Press, USA.
4. Girard J. Principles of Environmental Chemistry, James &Barlett Publishers, USA.
5. Harrison RM. Principles of Environmental Chemistry, RSC Publishing, UK.
6. Lancaster M. GreenChemistry:An Introductory Text, RSC Publishing, UK.
7. Manahan, S.E.Green chemistry and the ten commandments of sustainability, Chem Char Inc. Publishers, USA.



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Programme Name	Pre-Ph.D. Course Work	Programme Code	23-
Course Code	EVS -104(iii)	Credit	3
Year/Sem	1/1	L-T-P	3-0-0
Course Name	Biofuels		

Objectives of the Course:

To assess the methods of Biofuel with basic concept for application in research.

UNIT I(Total Topics-7 and Hrs- 10)

Production of bioethanol

Raw materials and pretreatment processes. Enzymatic hydrolysis of cellulose and hemicelluloses. Fermentation of monosaccharides. Types of Reactor. Use of Bioethanol.

UNIT II(Total Topics-6and Hrs-10)

Production of biodiesel

The transesterification reaction Raw materials and pretreatment processes. Separation and purification stages Qualities of biodiesel.

UNIT- III (Total Topics- 7 and Hrs-10)

Biogas and Biohydrogen

Anaerobic digestion, Anaerobic digestion, Bioreactors for the production of biogas and scope. Production of biohydrogen by dark fermentation and photo-fermentation.

UNIT-IV (Total Topics- 8 and Hrs-10)

UV-VIS. Spectroscopy

UV-VIS. Spectroscopy - Electromagnetic spectrum, Basic Principle of Spectroscopy, Lambert Beer Law, Absorption and transmission, Energy Level Transitions In Spectroscopy, UV and Visible Spectroscopy and its Instrumentation.

UNIT-V (Total Topics- 5 and Hrs-10)

Unit- Infra-red Spectroscopy

Principles of Infra-red and Near Infra-red (NIR) Spectroscopy. Fundamental modes of vibration, Instrumentation and simple Applications.

CO-1: Learn production of biogas, biohydrogen, biodiesel and bioethanol.

CO-2: Knowledge of pre-treatment, transesterification, anaerobic digestion and other processes will be given.

CO-3: Inculcate knowledge about UV-Vis and Infrared Spectroscopy.

Reference Books:-

1. Bioenergy and Biofuel from Biowastes and Biomass, ACEBooks, Edited by Samir K. Khanal; ISBN



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(print): 978-0-7844-1089-9ISBN (PDF): 978-0-7844-7330-6,2010.

2. Handbook of Biofuels Production, Elsevier,2010.
3. Green Nanotechnology for Biofuel Production,Book, Editor-Pramod W. Ramteke, Himanshu Pandey, Neha Srivastava, Manish Srivastava, P. K. Mishra 2018.